PEATLAND POCOSINS

Concept: Peatland Pocosins are saturated wetlands of Coastal Plain flats, swales, and Carolina bays, with organic matter accumulation (Histosols or histic surface layers), and with distinctive vegetation characterized by *Pinus serotina* and a suite of shrub species. Most of the pocosin shrub suite is evergreen and most are members of the Ericaceae. Vegetation structure ranges from woodlands or nearly closed forests to dense shrublands to herb-dwarf shrub vegetation sharing most of these species.

Distinguishing Features: Peatland Pocosins are distinguished by the above combination of characters. The suite of characteristic pocosin species consists of *Lyonia lucida, Ilex glabra, Ilex coriacea, Zenobia pulverulenta, Cyrilla racemiflora, Chamaedaphne calyculata*, along the vine *Smilax laurifolia*, and the trees *Pinus serotina, Gordonia lasianthus, Magnolia virginiana*, and *Persea palustris*. A couple communities are dominated by *Arundinaria tecta*. Some combination of this suite dominates, most species are usually present, and few additional woody species are present. A few other communities share dominance by these species, but occur in different environmental settings and have additional species characteristic. The most closely related theme, Streamhead Pocosins, shares much of the flora but occurs in seepage-fed drainages in sandhill terrain rather than on flats or in large basins. *Liriodendron tulipifera* and *Toxicodendron vernix* are additional characteristic species. Several Coastal Plain Small Depression communities share many species, but occur in small depressions with an influence of surface water flooding and have some additional species such as *Nyssa biflora, Taxodium ascendens*, and several deciduous shrubs. Coastal Plain Nonalluvial Wetland Forests share some of the species, but are dominated by different trees. Wet Pine Savanna communities may be invaded by pocosin shrubs with the long absence of fire, but will have mineral soils and often will have remnants of savanna species.

Within the theme, communities are distinguished by variation in typical vegetation structure, which reflects a gradient of wetness and peat depth. Variations in vegetational composition distinguish some types and subtypes. Pocosin Opening and Low Pocosin communities occur on the deepest peats, have shrub layers a meter or less tall, and have only sparse, stunted trees. High Pocosins occur on shallower peats, have shrub layers up to 2 meters tall, and can support somewhat larger and denser trees. Pond Pine Woodlands occur on shallower organic deposits, and have well-developed tree canopies of *Pinus serotina* and *Gordonia lasianthus*, while Bay Forests have well-developed canopies of *Gordonia, Magnolia virginina*, and *Persea palustris* without appreciable pine. Peatland Canebrake is distinguished by a largely treeless bed of *Arundinaria tecta* in a peatland setting.

Synonyms: Tall pocosin, short pocosin, evergreen shrub bog.

Sites: Peatland Pocosins occur on broad interstream flats in the outer Coastal Plain, in large Carolina bays, and in swales in relict dune fields with low relief – poorly drained settings where organic matter has accumulated. The most extensive pocosins are domed peatlands produced by paludification.

Soils: Examples occur on Histosols or on Spodosols with an organic surface layer. Organic matter thickness may range from shallow layers where plant roots may be able to reach the underlying mineral soil, to peats several meters deep. All soils are extremely acidic and poor in nutrients. Hungerford and Ryan (1988) studied soil structure and found hummocks to be an important part of soil structure and a large pool of soil carbon.

Hydrology: Sites are saturated but do not have standing water other than very locally, and do not receive flowing water input from mineral soil areas. The centers of domed peatlands receive water only from rainfall; edges of domed peatlands also receive water by sheet flow the center. The lower layers of organic matter have low hydraulic conductivity (Daniels, et al. 1977), limiting downward movement of water even as water moves frees through less compact upper layers. Water tables may thus be perched, and water is also retained by the high water holding capacity of peat. Examples in swales may also be affected by a seasonal high water table. Water in natural sites exits through sheet flow.

Vegetation: Vegetation is characterized by a dense shrub layer consisting of *Lyonia lucida, Ilex glabra, Ilex coriacea, Zenobia pulverulenta, Cyrilla racemiflora, Chamaedaphne calyculata*, *Persea palustria, Magnolia virginiana, Gordonia lasianthus,* rarely *Arundinaria tecta* or *Vaccinium macrocarpon*, along the vine *Smilax laurifolia*, and typically is nearly impenetrable. The shrub layer may be up to 2-3 meters tall or may be a meter or less tall in deeper peats. Tree canopy structure can vary widely with peat depth; the canopy usually is dominated by *Pinus serotina*, alone or with *Gordonia lasianthus*, but may be dominated by *Gordonia* with *Magnolia virginina* and *Persea palustris*. *Acer rubrum* var. *trilobum* may invade in the long absence of fire, but no other trees are present. Characteristic herbaceous species are *Anchistea virginica, Carex striata, Andropogon glomeratus, Sarracenia flava, Sarracenia purpurea*, and *Sphagnum* spp. These species may be abundant in Pocosin Opening communities, but otherwise are sparse. *Andropogon* may be abundant immediately after fire.

Dynamics: Pocosins are naturally influenced by occasional catastrophic fires. The leaf litter is normally saturated and will not burn, and the vegetation normally is not flammable. Many of the pocosin shrub species are known to be volatile and to burn more readily in the spring, when fresh leaves have emerged. Nevertheless, the frequent fires burning in adjacent longleaf pine communities generally do not ignite pocosins, and fire will not carry through the vegetation at most times.

In times of drought, plants, leaf litter, and surface peat dry and become flammable. When they occur, fires are intense and uncontrollable, generally killing most or all the above-ground vegetation, often consuming all but the trees and larger shrubs. Peat may ignite locally and smolder for weeks or months. In areas with artificial drainage, peat may burn more extensively and a foot or two of material may be lost. Ignition and sustained burning of peat depends on complex factors of moisture content, bulk density, and mineral content (Reardon, et al. 2007). Hummocks may be an important factor in igniting peat, since they are drier and less compact.

Pocosin vegetation is well adapted to recovering from catastrophic fire. *Pinus serotina* is able to survive severe fires that kill its branches, through epicormic sprouting. It has serotinous cones which store seeds on the tree for several years and release them when heated; it thus can establish seedlings on newly burned surfaces. All of the characteristic shrubs, hardwoods, vines,

and herbs sprout vigorously after being top-killed. Christensen, et al. (1981) reported that a burned pocosin regained 20% of its prefire biomass in the first growing season, and vegetation can be observed to be back to its characteristic structure after just a few years. Some species, such as *Zenobia* and various herbs, recover particularly quickly and dominate for several years after a fire, until they are out-competed by *Lyonia.* Species diversity is generally highest right after a fire, and declines gradually. As time since fire increases, an increasing amount of dead twigs and vines can be found on the standing shrubs. This presumably increases the flammability of the vegetation.

Where fire burns into the peat deeply enough to kill the roots of shrubs, a long-lasting wet basin may form. Deep peat burn patches are believed to be the origin of the patches of Pocosin Opening communities. These depressions are presumed to slowly fill with organic matter until they can support Low Pocosin shrubland vegetation. These communities may therefore form a shifting mosaic over time. However, in observing a number of pocosins that have had intense fires, I have not seen an increase in Pocosin Openings and their associated plants after fire.

As is characteristic of bogs, pocosins are limited not just by wetness but by extremely low availability of plant nutrients. Nutrients are not released by decomposition both because of the saturated soil and because of the high carbon and low nutrient content of most of the litter. Phosphorous has been found to be the limiting nutrient (Wilbur and Christensen 1983). The rapid growth following fire presumably is because of the sudden release of phosphorous and other nutrients in the ash.

Otte (1981) described the longer term dynamics of the large pocosin complexes, inferred from peat sampling. Most peatlands originated in blocked drainage systems, which are indicated by channel-like bands of deeper peat. Through paludification, the organic layer thickened and spread out of the channel across the flat uplands; some even spread across drainage divides. Peat accumulation, and presumably the blockage, began 10,000-12,000 years ago. Sea level was about 25 meters lower then, and the coast was distant enough that coastal processes probably were not involved. The cause of blockage is unknown, but channels appear to end at areas of sandy sediment, so sand movement may have been involved. Most peat deposits started as herbaceous marsh, and changed to cypress or white cedar swamp, leaving numerous logs in the peat. Shrubby pocosin vegetation developed relatively late in the accumulation of most peatlands, though still presumably millennia ago and apparently driven by natural causes. He also indicated that peatland pocosins were still expanding, peat deepening, and thus central pocosin vegetation getting lower at present, or at least they were until artificial drainage and soil disruption at the edges put an end to the process.

Otte (1981) also mentioned the idea of secondary pocosins, pocosin shrub vegetation that has developed in historical times after swamp forest was logged and was unable to regenerate. This may be possible because the loss of evapotranspiration would increase the wetness after logging. However, he also noted that peatland swamp forests occurred on peats with higher mineral content, especially clay, and in places where some overland flow brought nutrients into the site, rather than being indistinguishable from pocosin sites. Historical records sometimes used to support the idea of recently developed, anthropogenic pocosins, do not seem to be specific enough about locations. As an example, a large volume of timber was removed from the Green Swamp, where pocosin now dominates the remaining natural vegetation. However, given the much larger extent of swamp

in the past on different soils, it is likely that the pocosin existed at the time of logging and was ignored because it lacked merchantable timber. Indeed, it remains because it was not suitable for conversion to pine plantation at the time the rest of the swamp was.

Frost (2000) suggested it was likely there was short vegetation resembling Low Pocosin on shallower peats, kept low by frequent fire. Given the greater frequency of the fire in the past, this is possible. Wells (1946) also thought that a fire interval of 4-6 years would keep shrubs low, while not allowing *Zenobia* to become dominant. However, no existing Peatland Pocosin vegetation appears to behave in this way at present. Pocosin vegetation seems to need time to become flammable after fires, and to be incapable of burning frequently.

There is a more general concept of a potential long-term shifting mosaic of communities of shallow organic soils. Pond Pine Woodland, Bay Forest, Peatland Atlantic White Cedar Forest, Nonriverine Swamp Forest, even High Pocosin and Low Pocosin, are suggested to be results of different disturbance histories, with an implication that their sites could readily become any of the other communities. Various sources describe bay forests as an end stage of succession for Peatland Atlantic White Cedar Forest, Pond Pine Woodland, or shrubby pocosins with the long absence of fire (Buell and Cain 1943; Kologiski 1977). Christensen (1988) suggests that shallow peat burns may allow *Chamaecyparis* or *Pinus serotina* establishment. This appears reasonable, and may be true, but field evidence is hard to find. Landscape patterns of existing occurrences do not resemble patch mosaics but look more like zonation based on site factors. Those site factors may include chronic disturbance regimes, influenced by natural fire breaks or connections to more flammable vegetation, but are less likely to change over time. However, disturbance history has more potential to influence communities in transitional areas, potentially shifting boundaries from one time to another.

Comments:
The primary terminology and concepts of types used here follow Otte (1981), and are little changed from were published in Weakley and Schafale (1991). A competing terminology of "tall pocosin" and "short pocosin", not used, is based on the same gradient of peat depth and vegetation stature. Otte (1981) made extensive observations of vegetation as well as site conditions while sampling peat in pocosins. Despite its never being formally published, this work has been widely cited. Except where noted, I have corroborated most of his observations of the patterns of Low Pocosin, High Pocosin, and Pond Pine Woodland. Though using other terminology, Snyder (1980), Wells (1946), and Dachnowski-Stokes and Wells (1929) noted similar patterns. Pocosins are often called evergreen shrub bogs in literature, but as Christensen, et al. (1981) noted, some are dominated by deciduous species.

Descriptions of pocosins in literature are often confusing, partly because of different uses of terminology and partly because of confusion of boundaries by alterations such as logging and fire exclusion. The term "bay forest" has been used in a variety of ways, many of which are much broader than used here. The difficulty of penetrating pocosin sometimes leads to samples being taken in uncharacteristic areas on the edges. Many of the CVS plots, for example, contain species not characteristic of well-developed pocosins. Christensen, et al. (1981), for example, mention *Pinus palustris* as potentially present in pocosins, but this species would be present only in overgrown mineral soil edges that have come to deceptively resemble pocosins.

The linking of canebrakes to pocosins is somewhat problematic. Westward, canebrakes are associated with large river bottoms. In the Coastal Plain, however, despite the presence of *Arundinaria* along rivers, canebrakes appear to have been associated with streamheads and with organic wetlands. Most of the few remnants are associated with pocosins. However, the best documented historical canebrake, The Green Sea, appears associated with Coastal Plain Nonalluvial Wetlands and other examples may also have been. Bay Forest too is sometimes associated with Nonalluvial Wetlands rather than with other Peatland Pocosin communities.

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